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ABSTRACT

This guidebook resulted from a student mentoring and teacher ambassador project in applied science in Wyoming. For the teacher-ambassador component of the program, seven science and vocational teachers interned in science-related industries to investigate technical-level jobs at 11 business and industry sites. They documented skills needed by workers in those jobs, looking at science and other core of knowledge skills such as communications, mathematics, biology and chemistry, and technology. This guidebook used by the teachers in the project lists the businesses investigated, the contact person at each site, a description of the worksite, the basic skills used on the jobs, the technical skills used in the jobs, and suggested applications to the classroom and the school district. Questions to be answered by students on field trips to the companies are also included. (KC)

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Ambassadors in Industry

Integrating the Curriculum

LCSD #1

Cheyenne, Wyoming

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and
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Vocational-Academic Integration - The Infusion of Mentoring Partnerships with Business and Industry

Introduction: Our district received a Wyoming Innovative Trust Fund Grant to initiate a student mentoring and teacher ambassador project in applied science.

a. At-risk high school students mentored with community college students to become more familiar with the campus. These same students mentored in science-related industries to better understand technical level careers in science and math. Steps:

1. Investigate liability insurance and labor laws
2. Locate community college mentors
3. Development of industry mentor agreements
4. Train mentors
5. Set up mentorships
6. Introduce students, mentors, and parents through dinner to go over program
7. 20 hours mentoring experience
8. On-going evaluation and communication with mentors
9. Thank you luncheon and recognition
10. Follow up of students after graduation

b. Seven science and vocational teachers interned in science-related industries to investigate technical level jobs at those business and industry sites. They documented skills needed by workers in these jobs, looking at science and other core of knowledge skills such as communications, math, biology/chemistry, and technology. Steps:

1. Investigation of liability insurance and labor laws
2. Development of application process for teachers
3. Organization of selection committee
4. Publicity throughout the school district
5. Investigation of preliminary work sites/industry "buy in"
6. Application deadline and selection of Ambassadors
7. Organization of credit with SDE and University of Wyoming
8. Visitations to industry sites and intern scheduling
9. Internships implemented
10. Development of employability materials for core of knowledge, technical and employability skills
11. Thank you luncheon and follow-up letters, publicity for business and industry, and teacher recognition
12. Teacher feedback and materials to curriculum committees

c. Subsequent integrated curriculum activity implemented to show the relationship of school to the industry explored. Steps:

1. Instructional staff "buy in"
2. Industry field trip experience scheduled
3. Pre-trip study guide developed
4. Field trip and completion of study guide
5. Written project analysis. Choose a job observed and explain by giving examples or describing a day at work, i.e. how math, science, communications, technology, and social studies are used in that job.

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Can students excel in science by year 2000?

By TIMOTHY GOLDSMITH
National Academy Op-Ed Service

Nine years to go. That's how long U.S. students now have to become first in the world in mathematics and science achievement.

At their "education summit" last September, President Bush and state governors set the year 2000 for students to accomplish this goal. Their challenge came as Americans have been debating educational reforms ranging from lengthening the school year to requiring better teacher-competency tests.

Yet American students have little hope of catching — much less surpassing — their counterparts in Japan, Britain and elsewhere until something more fundamental happens. Our science classrooms must stop being so dreadfully boring and irrelevant.

I chaired a committee of the National Research Council that recently examined the most widely taught science subject — biology. We found that biology is taught so poorly in the United States that it frequently snuffs out student interest in all science. Four of every five students take biology in high school, but fewer than a third of them continue with science by studying chemistry. Less than half of chemistry students, in turn, take high school physics. We cannot possibly meet our deadline of the year 2000 with this commitment.

Dismal enrollment figures do not tell the whole story. A recent analysis found that fully half the students who never take a class in biology do as well or better on biology tests than 40 percent of their peers who took and passed a biology class. In other words, many students learn almost nothing in these courses — except to dislike science.

Biology classes should be helping students develop an interest in the world around them and an understanding of societal issues such as AIDS and the environment. But from the early grades to high school, biology education is hampered by poorly trained and supported teachers, irrelevant curricula, inappropriate standardized tests, and textbooks that often are inaccurate or misleading. Considerable evidence suggests that the same problems exist in other science classrooms.

Biology and the rest of science need to become an essential part of elementary school, while the curiosity of children is uninhibited. Instead, most students receive little science instruction until junior high school, and then with curriculums exercises in memorization rather than an intellectual voyage of exploration.

What's needed is a curriculum that emphasizes science as a process of understanding. It should be an open-ended game of "What if ...?" rather than a stupefying exercise in memorizing terminology reinforced by pedantic standardized tests. Students need to confront their beliefs about cause and effect, and spend time experimenting with their own hands and eyes, in simple laboratory settings.

Teachers need better training and should stop being so constrained by bureaucratic directives, non-educational duties, and insufficient time to prepare class materials. They also need many more opportunities for meaningful in-service experiences in which they can interact with research scientists, upgrade their knowledge, and share ideas and experiences.

From a national perspective, the most important need is to keep sight of these day-to-day realities in the classroom as we consider other reforms. Most of the "solutions" that have received attention lately are largely managerial or administrative.

Examples include lengthening the school day or the school year, requiring more multiple-choice tests to establish the competence of teachers or the progress of pupils, opting for alternatives to the traditional certification or licensing of teachers, and adjusting the relative authority of teachers, principals, superintendents, and boards of education. A voucher system, allowing parents to choose their child's school, is the latest such enthusiasm.

Some of these approaches contain useful ideas. But few specify or assure the kinds of fundamental change that are most necessary to improve learning, those that must take place in the classroom.

Significant improvement among U.S. students in science cannot occur without better training for teachers, more relevant curricula and textbooks, and tests that focus on concepts rather than terminology. These fundamental reforms are the first step to young Americans' excelling in science — and in the complex world of the future.

Only 15 percent of high school seniors now opt to take science, so students are voting with their feet about what's wrong. With just nine years to go, we should listen to them.

(Timothy H. Goldsmith, Ph.D., professor of biology at Yale University, chaired a committee of the National Research Council that examined the status of biology ed-

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Mentors

Program pairs kids, businesses

by Marnita Jondle

Laramie County School District 1 has found a way to bridge the gap between classroom theory and practical knowledge through a mentor program.

The adopt-a-mentor concept is being utilized by Eleanor Grinnell, the district's vocational-academic integration manager, in the Community Based Occupational Education applied biology and chemistry class.

The project was funded through a grant from the Wyoming Centennial Education Trust Fund, established by the state Legislature in 1991. The grants are used to encourage innovative and creative programs in the state's 49 school districts.

According to Grinnell, the local program has three phases. The first phase deals with students from Laramie County Community College interacting with applied biology and chemistry students, similar to a pre-student teaching activity. Grinnell explained that LCCC students have helped bridge a gap for the high school students. She said the LCCC students have worked with students in the alternative high school program, and in turn the high school students have attended classes at LCCC.

The second phase, which is coming to a close for the first semester, teams applied biology and chemistry students with local businesses. The students spend 20 hours with their industry mentors, learning practical knowledge while relating classroom theory.

"The curriculum tries to help bridge the gap between theory and practical knowledge," Grinnell said. "The mentoring program helps students apply the theory they learn in class to a real-life situation. It's a way to show students that what they learn in class is important and will be used for the rest of their lives."

The third phase of the program is geared for vocational and science teachers in the district. Vocational and science teachers had to apply to be an industry ambassador for the month of June. The ambassadors are Dan Denning, Central High School; Larry Johnson, McCormick Junior High School; Marcia Kinder, Davis Elementary School; Dan Ley, East High School; Janet Locks, Central High School; Lisa Snyder, McCormick Junior High School; and Carolyn Stoner, Carey Junior High School.

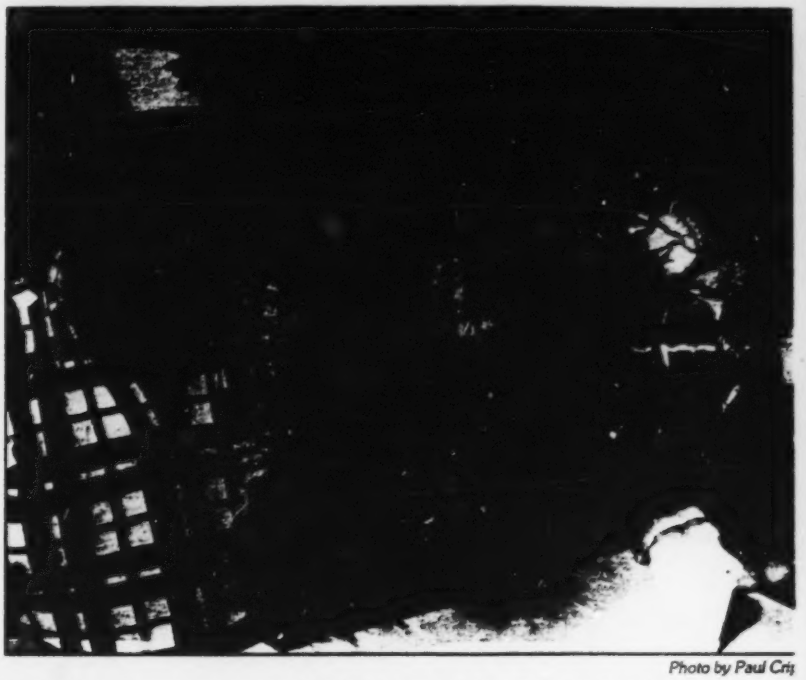

Photo by Paul Cri

Mark Mickle (l) observes a water sample held by his mentor, Tom Fergerson, from the city water depar ment.

Grinnell explained the teachers will work for 20 days in four or more work settings so that teachers gain a knowledge of industry needs and integrate that into their classrooms.

Grinnell said hopefully the program will lead to some type of pre-apprentice programs for vocational students.

She added that by introducing the students to certain employment opportunities, they might be able to choose a favorable career route before entering college, thus saving money in the long run.

Also, Grinnell hopes that a pre-apprentice program would lead into an apprenticeship program for a student upon graduation.

"At the very least, this program has industry and teachers talking about the education of students and what students will need to be successfully employed," she said.

One mentor, Linda Stratton, from the food and drug division of the U.S. Department of Agriculture, said she enjoyed working with student Becky Hathaway. Stratton explained that her job is sanitation inspections, and she took Hathaway to a dairy farm to take milk samples, and then on to the department's laboratory in Laramie where sample reports are completed.

Other mentoring "teams" include: Jan Hough, from the state Department of Health, paired with Hollie Pinkley; Dr. Teresa Drummond, veterinarian, teamed with Tori Woodrum and Tina Runion; Dave Lockman, from the Game and Fish Department, paired with Angie Grooms; Sabrina Grigsby from Cheyenne Radiology, paired with Lisa Sheheen; Greg Brehmer, electrician, teamed with Jaso Spencer; Evelyn Downey fror Memorial Hospital, teame with Tavy Ellis; Tom Ferge son, Cheyenne Water Trea ment Plant, and Jack Young Dry Creek Waste Water Trea ment Plant, both paired wit Mark Mickle; John Miscol Bud Anderson, and Lind Stratton, all from the U.S. De partment of Agriculture teamed with Becky Hathaway and Barbara Cabot and Bo Schick, state Department c Air Quality, paired with Da Martinez.

The state grant monie for this project end in June and Grinnell has plans to re apply. However, if the pro gram is turned down for a sec ond year, Grinnell is confider that it will be continued.

"The district will pay no ou of-pocket money," Grinne said. "The grant monies wer used to purchase scienc equipment and take field trip Now that the equipment ha been purchased, there will b no real expense to the distric except a teacher's salary an benefits."

Marnita Jondle works in public r lations for Laramie County Scho District 1.

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GUIDEBOOK TO LOCAL INDUSTRY SKILLS NEEDED FOR WORKFORCE 2000

June 1992

Laramie County School District Number One
Cheyenne, Wyoming

AMBASSADORS IN INDUSTRY
APPLIED BIOLOGY/CHEMISTRY
WYOMING INNOVATIVE TRUST FUND GRANT

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Business/Industry Sites Explored by Teachers/Ambassadors

1. **Wyoming State Crime Laboratory**
   - Lisa Snyder and Larry Johnson

2. **Teledyne Water Pik**
   - Daniel Denning

3. **Wyoming Department of Agriculture**
   - Dan Ley

4. **Cheyenne Water Treatment/Dry Creek Waste Water Treatment**
   - Marcia Kinder

5. **Wyoming Department of Health**
   - Carolyn Stoner

6. **University of Wyoming/Laramie County Extension Service**
   - Lisa Snyder

7. **Wyoming Department of Environmental Quality/Water Quality Lab**
   - Janet Locks

8. **DePaul Hospital**
   - Carolyn Stoner and Marcia Kinder

9. **Memorial Hospital**
   - Larry Johnson

10. **Warren Analytical Laboratory**
    - Janet Locks

11. **Wyoming Game and Fish Department**
    - Dan Ley

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Applied Communications

During this field trip you will have many opportunities to observe how Applied Communications is used in the Dairy/Beef production business. Please answer the following questions.

1. List and describe at least 5 types of jobs that you have seen on this field trip. Ex. Bookkeeper, computer technician.

2. Did you see a communication network in play?

3. What impact does communication have on these working environments?

4. Did you observe communication of company goals?

5. In one of the businesses you saw, give an example of why it is important to ask for help if one is not certain of job instructions?

6. What is meant by "listening is work"?

7. Did you see evidence of group work in one or more of the businesses?

8. If you did not see gender integration, why do you think it was not present?

9. Did you feel that there was rapport between employees and management?

10. If you wanted to work in one of these businesses (pick one), what would you have to do to prepare for the job. Ex. training.

11. Were your expectations of the businesses visited met?

Applied Biology/Chemistry

During this field trip you will have many opportunities to observe how applied biology/chemistry is used in the Dairy/Beef production business. Through observation and asking questions you will answer the following questions.

1. a. Compare and contrast how animal nutrition and human nutrition are inter-related.

   b. How have changes in human nutritional requirements encouraged changes in the animal food processing industry.

   c. How has human consumption of beef and dairy products changed over the past 10-15 years. What effect, if any has this had on the industry.

2. Contamination of food products, either from bacterial or chemical sources, is always a concern. What precautions did you observe or hear about that have come about to protect our food supply.

3. Give an example of a ruminant, and explain how their digestive system is different that the human digestive system.

4. What are some nutritional deficiencies that might effect cattle?

5. Are there any additives given to dairy or beef cattle and for what purpose? Are things like steroids and antibiotics used? Why might they be beneficial or hazardous?

6. Are any of the industries we visited affected by the world market? Give examples.

7. What part does safety play in the work place? Do they have routine safety training?

Family Living and the Work Relationship

1. Do any of the employees have children? What arrangements do they have for child care?

2. Do they have policies for family leave? What are they?

3. Do they have any wellness policies? Explain.

Applied Mathematics

During this field trip you will have many opportunities to observe how Mathematics is used in the Dairy/Beef production business. In addition to answering the following problems, keep track of what jobs and how many locations you see mathematics being used.

1. The Kingston family ranch has 320 cows. On the average, each cow eats a total of 2.396 tons of hay per year. The Kingstons expect to bale about 1,015 tons of hay this year.
   a. How much hay is needed to feed the cows this year?
   b. Compare this to the amount of hay baled by the Kingstons. Will they need to buy more hay for the cows, or will they have to sell leftover hay? How much?

2. A sample of milk contains 4% fat, 5% carbohydrate, and 3.5% protein.
   a. Express the percent fat in milk as a decimal.
   b. How many grams of fat are found in an 8-ounce serving of milk that weighs 250 grams?
   c. If each gram of fat has 9 calories in it, how many calories does the serving of milk provide?
   d. What percentage of milk may be water?

3. You have a 300-acre range that produces 2000 lb/acre of forage during the growing season. (FOrage is food for grazing animals.) To protect the range, you want no more than half the forage eaten. Your cows each eat 30 pounds of forage per day. How many days should you permit your head of 50 cattle to graze on the range during the growing season?

4. The pricing for many farm products is given in dollars per hundred pounds (or hundredweight, abbreviated cwt). For example, milk may sell at a price of $13.80 per cwt.
   a. What would be the price of milk **per pound**, rounded to the nearest penny?
   b. Suppose milk were priced "per pound" instead of "per hundred pounds." If the price per pound increased one penny (for example, from 14 cents per pound to 15 cents per pound), what would be the increase in **cost per hundred pounds**?

5. The table on the following page shows that hay may be substituted for the more expensive grain, and still produce a similar effect on a feeder steer.

Ambassadors to Business and Industry 1992
Applied Biology/Chemistry/Technology
Laramie County School District Number One
Cheyenne, Wyoming

Business/Industry Name: Anheuser Busch

Business/Industry Address: 2351 Busch Drive, Fort Collins, CO 80522

Contact Person: Brian Bishop **Phone:** (303) 490-4550

Assignment Date(s): 3 June 1992 (Tour of Plant and Quality Control Lab)

Description of Worksite: This Budweiser plant produces their product for six western states and distibutes it by trucks. The plant employs approximately 600 people. Much of the work is shift work. One third of the employees have only a high school education with experience, one third have a high school diploma plus two years post secondary education and experience, and one third have a college degree in various science, engineering, or business related fields. The quality control lab is responsible for analyzing and monitoring the product throughout the brewing process.

***** BASIC SKILLS USED ON THIS JOB *****

1. **Reading, vocabulary:**
   - tour guide had to read and memorize information regarding the plant and its operation
   - training manuals
   - specialized vocabulary for beer making industry
   - warning signs/safety procedures

2. **Writing, word processing, forms:**
   - lab reports, labelling of containers
   - clerical staff
   - record keeping for transportation

3. **Listening and oral communication:**
   - communicate specifications of packaging materials to suppliers
   - communications between departments
   - public relations
   - tour guide needed public speaking experience
   - safety

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***** BASIC SKILLS (Con't) *****

4. **Computation, statistics:**
   - lab tests
   - specific gravity vs. weight
   - measure compounds at different stages of fermentation
   - averaging

5. **Problem solving, critical thinking:**
   - averaging brew specifications to mix to proper levels
   - checking cans to determine point of malfunction in sealing process
   - determine cause of slightly detectable flavor differences
   - understanding the general chemistry behind the brewing process in order to troubleshoot effectively

6. **Organizational skills, negotiation and teamwork:**
   - scheduling for the production of 12 different beer types
   - all workers are stockholders
   - many workers did appear to be working fairly independantly of one another

7. **Learning how to learn, adapting to change:**
   - training is on-going
   - "we're automated as far as we can go. We need to hire people who can think"

***** TECHNICAL SKILLS *****

1. **Laboratory procedures:**
   - proper sampling and labelling procedures
   - record keeping
   - use of a microscope
   - tasting
   - microbiology
   - membrane filtration
   - use of glassware
   - pH, temperature

2. **Chemistry used:**
   - pH, acids, caustics
   - O2 test
   - gas concentrations
   - enzymatic reactions
   - fermentation
   - air test
   - titration
   - starch/sugar content

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***** TECHNICAL SKILLS (Con't) *****

3. **Biology concepts:**
   - aerobic vs. anaerobic processes
   - yeast cultures
   - pasturization
   - bacteriology
   - microbiology

4. **Computer technology:**
   - ion analysis
   - lab was highly automated
   - entire brewing process was controlled by one experienced brewer at a brewing control panel in main control room
   - gas chromatography
   - packing efficiency analysis

5. **Other concepts:**
   - most waste was recycled
   - pressure/temperature relationships
   - sanitation, sterilization, shelf life

***** PROCESS EVALUATION *****

1. **Classroom changes:**
   - more exposure to instrumentation
   - stress lab safety
   - more quality control

2. **Suggestions for school district:**
   - more computerization - using the computer as a tool for data collection and analysis
   - temperature probes, pH probes, graphing

3. **General comments:**
   - Brian Bishop was friendly and knowledgeable
   - clean, comfortable working environment

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Applied Biology/Chemistry/Technology
Laramie County School District Number One
Cheyenne, Wyoming

Business/Industry Name: Hewlett Packard

Business/Industry Address: 3404 East Harmony Road, Ft. Collins, CO 80525

Contact Person: Barb Platt/Judy Lopo **Phone:** (303) 229-2616

Assignment Date: 3 June 1992 (Tour of Plant)

Description of Worksite: The main focus of the Hewlett Packard plant in Fort Collins is the design and manufacture of IC (integrated circuit design) chips and circuit boards that go into personal computer workstations. They are also becoming more involved in software development. They employ approximately 2700 people most of which have at least four years of college. Most non-technical service related jobs have been eliminated because these services are now subcontracted out.

***** BASIC SKILLS USED ON THIS JOB *****

1. **Reading, vocabulary:**
   - following directions in manuals
   - reading schematics
   - interpreting process flow charts
   - notices outside of department sections
   - scientific and engineering terminology

2. **Writing, word processing, forms:**
   - writing of training manuals
   - operations instructions
   - software development

3. **Listening and oral communication:**
   - team communication/group discussion
   - interdepartmental communication
   - communication with other companies

4. **Computation, statistics:**
   - graphs
   - charts
   - process flow charts

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***** BASIC SKILLS (Con't) *****

5. **Problem solving, critical thinking:**
   - [illegible] down the book and follow directions
   - maintaining cleanliness of clean rooms
   - troubleshooting circuit boards
   - financial planning due to job instability

6. **Organizational skills, negotiation and teamwork:**
   - HP is organized on the team concept
   - everyone is accountable to their team
   - "management by wandering around"

7. **Learning how to learn, adapting to change:**
   - many changes were occurring in the company
   - restructuring set new priorities
   - employees needed to be flexible and adaptable to change

***** TECHNICAL SKILLS *****

1. **Laboratory procedures:**
   - safety
   - cleanliness (clean rooms)

2. **Chemistry used:**
   - hazardous chemicals used in the development of chips

3. **Biology concepts:**
   - environmental concerns/waste disposal

4. **Computer technology:**
   - integrated circuits
   - [illegible] boards
   - [illegible] design
   - hardware design
   - software design

5. **Other concepts:**
   - ergonomics
   - management philosophy - wellness, flexible, casual
   - company is changing from a strict scientific/engineering emphasis to a PC/workstation/software emphasis

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***** PROCESS EVALUATION *****

1. **Classroom changes:**
   - employ more techniques to establish organized groupwork
   - use team concept to learning
   - implement more critical thinking activities where group members are dependent on other group members

2. **Suggestions for school district:**
   - continue investigating team problem solving approach

3. **General comments:**
   - workplace appeared casual and nonproductive but due to the high tech level of the product, much more work was probably being accomplished than what appeared

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Ambassadors to Business and Industry 1992
Applied Biology/Chemistry/Technology
Laramie County School District Number One
Cheyenne, Wyoming

Business/Industry Name: Betz Laboratories

Business/Industry Address: 311 Cleveland Place, Cheyenne, WY 82007
Mailing Address: P.O. Box 5059, Cheyenne, WY 82003

Contact Person: Ken Dunlap, Plant Manager **Phone:** (307) 637-7336

Assignment Date(s): June 1, 1992 (Plant Tour)

Description of Worksite: This plant was opened in Cheyenne in September, 1991. It is a very modern facility with up-to-date, state-of-the-art equipment. The main function of this plant is to custom mix chemicals for industrial water treatment to clients specifications.

The plant employs six people: one plant manager, one secretary, and four plant workers. One truck driver operates out of this plant but is controlled by a distribution center located elsewhere. All of the plant employees (with the exception of the secretary) have been trained and are required to perform any and all tasks pertaining to plant operation.

Starting salary is $15.00 per hour for the plant workers. Worker training lasts for about a year with an actual probationary training period of six months.

***** BASIC SKILLS USED ON THIS JOB *****

1. **Reading, vocabulary:**
   - the interview process includes a reading and vocabulary test
   - workers must be able to read and follow directions in the procedural [illegible]
   - extensive training manual
   - labels on drums list important information regarding toxicity of contents

2. **Writing, word processing, forms:**
   - application may include a writing sample
   - secretary needed word processing skills
   - workers were writing their own procedures manual based on what they had learned in their training

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***** BASIC SKILLS (Con't) *****

3. **Listening and oral communication:**
   - much of training information is given orally
   - sales people are engineers who listen to and evaluate the client's needs and and then come up with a solution
   - truck driver responsible for a large part of their public relations work - must be able to communicate effectively with clients

4. **Computation, statistics:**
   - pounds to gallons
   - fractions to decimals
   - percentages
   - read and interpret data tables, graphs, charts

5. **Problem solving, critical thinking:**
   - determine order of steps for mixing chemicals to minimize waste
   - determine which batches to mix first based on compatibility with chemicals in other batches and processing time
   - determine when and how much of the total solvent (water) amount to add to mixture so that hoses can be rinsed at the end of the mixing process by solvent that will go into the batch being mixed

6. **Organizational skills, negotiation and teamwork:**
   - see comments under problem solving
   - many tasks are accomplished by teams: safety team, procedures manual team
   - time management

7. **Learning how to learn, adapting to change:**
   - all workers required to do all jobs

***** TECHNICAL SKILLS *****

1. **Laboratory procedures:**
   - workers tested samples from the batches they mixed
   - volume measurements (graduated cylinders, pipettes), pH, temp
   - safety procedures were stressed

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***** TECHNICAL SKILLS (Con't) *****

2. **Chemistry used:**
   - pH tests
   - following written procedures ("recipe")
   - knowledge of chemical reactions
   - temperature changes and reasons for them

3. **Biology concepts:**
   - environmental concerns regarding waste disposal and recycling of containers

4. **Computer technology:**
   - separate computer for printing of labels for containers
   - mixture recipes on corporate computer network
   - computerized balances/scales
   - described by one worker as a "push button" operation

5. **Other concepts:**
   - mechanical engineers
   - pneumatics
   - workers did their own maintenance whenever possible
   - meter reading

***** PROCESS EVALUATION *****

1. **Classroom changes:**
   - stress procedures and following directions
   - stress quality assurance and mental checks of work
   - stress safety, cleanliness, putting things away at end of project

2. **Suggestions for school district:**
   - suggested outcome for outcome based: Student will be able to follow a list of procedural steps from beginning to end to come up with a finished product.

3. **General comments:**
   - great, informative tour
   - information packet was excellent
   - Ken Dunlap was very knowledgable

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Ambassadors to Business and Industry 1992
Applied Biology/Chemistry/Technology
Laramie County School District Number One
Cheyenne, Wyoming

Business/Industry Name: Frontier Refinery

Business/Industry Address: 2700 East 5th Street, Cheyenne, WY 82007

Contact Person: Greg Rust/Tony Simon **Phone:** (307) 634-3551

Assignment Date(s): June 1, 1992 (Plant Tour)

Description of Worksite: Frontier Refinery receives crude oil from Wyoming and Montana, refines it and produces the following products: premium, unleaded, and regular leaded gasoline, #1 and #2 diesel fuel, JP4, commercial jet fuel, asphalt, petroleum coke, LPG (propane), and elemental sulphur.

The plant employs approximately 200 hourly workers and 80 salaried staff. It also works in conjunction with approximately 150 contractors. The educational requirement for a large majority of the labor force at this plant is a high school diploma. Extensive on the job training occurs after hiring.

Hourly wage is from twelve to nineteen dollars an hour.

***** BASIC SKILLS USED ON THIS JOB *****

1. **Reading, vocabulary:**
   - numerous (30+) safety and technical manuals need to be read during the 2 week training and 6 month probationary period
   - warning signs and safety procedures posted throughout the plant

2. **Writing, word processing, forms:**
   - lab reports indicating test results
   - environmental reports (toxic spills, stack emissions)
   - clerical reports

3. **Listening and oral communication:**
   - communicate job needs to contractors
   - on the job training requires good listening skills
   - use of walkie talkies and radios
   - coordination/communication between departments
   - warning bells/sirens

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***** BASIC SKILLS (Con't) *****

4. **Computation, statistics:**
   - computerized truck loading (determine proper mixtures)
   - chart reading and interpretation of data tables
   - stack emissions statistics
   - determining mixing amounts of various octane levels to get desired percentage of final product

5. **Problem solving, critical thinking:**
   - understanding schematics and diagrams
   - constant evaluation of environmental emissions and corrections to meet appropriate levels
   - critical thinking in regard to safety
   - constant corrections and adjustments to instruments

6. **Organizational skills, negotiation and teamwork:**
   - maintenance schedules
   - working and coordinating with numerous contractors
   - union labor vs. management
   - organizing and integrating new plant construction to minimize down time

7. **Learning how to learn, adapting to change:**
   - many of the older workers were seeing the need to know more about computers
   - the plant operation was in the process of converting from a primarily manual type of operation to an automated, computerized operation

***** TECHNICAL SKILLS *****

1. **Laboratory procedures:**
   - anti-knock testing
   - analyzing crude oil for sulphur content and chemicals to be removed in refining process
   - analyzing product
   - safety, OSHA standards, hazardous materials classification
   - pH testing

2. **Chemistry used:**
   - pH tests - distillation - titration - cracking - flash point
   - vapor pressure in anti-knock lab - general organic chemistry

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***** TECHNICAL SKILLS (Con't) *****

3. **Biology concepts:**
   - biological contaminants of fuels
   - environmental protection, hazardous/toxic wastes

4. **Computer technology:**
   - clerical/word processing
   - computerized instrumentation
   - computerized plant operations and safety monitoring
   - adapting/customizing programs to fit plant requirements

5. **Other concepts:**
   - wastewater treatment
   - a great deal of mental processing ability required even in the highly labor intensive jobs that only require a high school diploma

***** PROCESS EVALUATION *****

1. **Classroom changes:**
   - stress using and following written instructions
   - have, and refer to, periodic tables in elementary schools and non-science classrooms
   - introduce students to circle graphs and a variety of data charting methods

2. **Suggestions for school district:**
   - provide students with more experience with (or exposure to) actual instrumentation
   - introduce students to the reality that many occupations require less than four years of college and that vocational training is an option that could be considered

3. **General comments:**
   - Tony Simon was an excellent guide and very knowledgeable of all aspects of plant operation
   - Industrial Hygienists are in low supply and high demand
   - working environment is noisy, cold, and smelly

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